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ON THE ASSOCIATION OF HUMAN REMAINS AND EXTINCT VERTEBRATES AT VERO, FLORIDA

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The presence of vertebrate fossils in deposits exposed near Vero in eastern Florida first became known in 1913. Fossil human remains were not found at this locality, however, until October, 1915. Subsequently additional human skeletal material was obtained in February, April, and June, 1916. The associated fossils, which are numerous and varied, have been collected practically continuously since the locality became known, although the largest collections are those made in February, 1915, and in February, April, June, October, and November, 1916. During the latter part of October the writer and his associates in Florida enjoyed and profited by the presence at this locality of Drs. Hay, MacCurdy, Hrdlička, Vaughan, and Chamberlin, all of whom are participants in the present discussion. The writer is also personally indebted to the several specialists in different branches of paleontology who have identified and described fossils from this locality, acknowledgment of which is made in the subsequent pages of this paper.

The discovery of human remains in association with extinct vertebrates at this locality was announced by the writer in the issue of the *American Journal of Science* of July, 1916. Later discoveries were described in *Science* in the issue of October 27, 1916. Subsequently, in the *Eighth Annual Report of the Florida Geological Survey*, published in October, 1916, the human remains and the associated fossils were more fully described. The present paper includes supplementary observations made during October and November, 1916.

SKETCH MAP OF THE LOCALITY

The fossils at this place were found in a stream bed and were discovered as the result of the construction of a drainage canal. As an aid in interpreting the section through the stream bed the reader may refer to the sketch map of the locality and surroundings shown in Fig. 1. The chief topographic features include a Pleistocene beach and the drainage system of the stream in which the fossils were found. On the east is the narrow body of ocean water known as Indian River and the beach of the present shore line. The ancient beach at this place is low, having an elevation of from 5 to 15 feet above the adjoining flat lands. Both to the north and to the south, however, the ridge formed by the beach becomes more pronounced. This beach, in fact, is a part of the extensive Pleistocene barrier beach which approximately parallels the present shore line for 200 or 300 miles in eastern Florida, and is comparable in origin to the modern or existing ocean beach which lies from one to six miles farther east. The land both in front and back of the beach is prevailingly flat and presents but little variation in level. Such minor elevations as are found tend to assume the form of ridges with a general north-south trend, separated by slight intervening depressions which not infrequently are imperfectly drained. A pronounced north-south ridge or beach is found about 10 miles inland and is known locally as Ten Mile Ridge.

The drainage system of the stream in which the fossils were found is very limited in extent and is controlled largely by the Pleistocene beach. The valley of the main stream, which has a width of from 350 to 500 feet, extends from tidewater in the Indian River into, but not across, this beach. Near the place where the fossils were found the broad valley terminates abruptly and receives a tributary from the north and another from the south, each of which, however, is of very limited extent. The tributary from the south reaches as far as the railroad station at Vero, a distance of about a half-mile, and one prong also finds its way across the beach and extends as an indefinite drain into the lowlands a distance of possibly a mile. The tributary from the north likewise divides: the west prong, crossing the beach, heads less than a mile to the northwest, while the east prong, which does not cross the beach, continues to the north, paralleling the beach to Gifford Station, a distance of about 1½ miles. The whole drainage system is thus very limited, involving only a few square miles, and is in striking contrast to the broad valley which the stream has developed in its lower course. Owing to the breadth of the valley, it may possibly be inferred that at some former time the stream had a larger drainage basin than at present. This, however, does not seem to have been the case, since a pronounced cut or stream channel across the beach, if made, would have persisted to the present time.

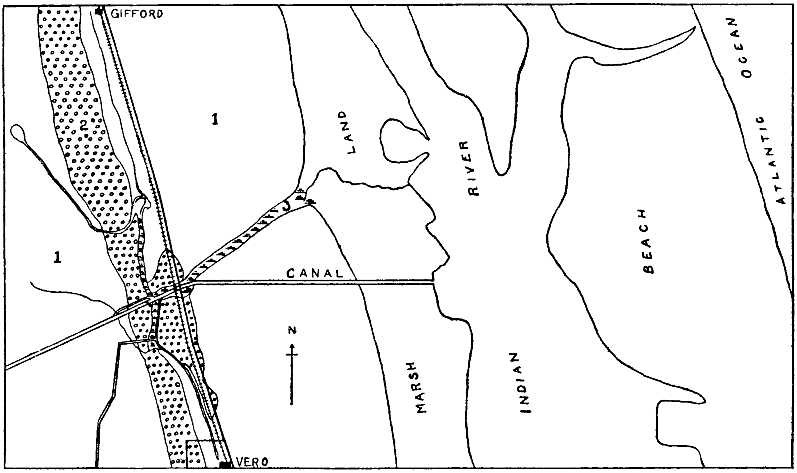

FIG. 1.—Sketch-map showing the locality near Vero from which fossil human remains have been obtained. Scale, 1 inch = 4,000 feet. No. 1, pine lands; No. 2, Pleistocene beach; No. 3, stream valley. The human remains were found in the canal bank in this valley, west of the railroad and of the public-road crossing.

The native vegetation is distinctive on the beach, on the flatlands, and in the stream valley. The beach is characterized by spruce pine, *Pinus clausa*, and by an undergrowth of shrubs in which evergreens predominate. The flatlands support a scattered growth of long-leaf pine, *Pinus palustris*, the undergrowth being chiefly saw palmetto. In the stream valley is found a dense timber growth consisting chiefly of hardwood deciduous trees and the cabbage palmetto. The outlines of the valley and of the beach may be very definitely followed by the vegetation, which is controlled in turn by the soil and by the drainage conditions.

The drainage canal, which starts at sea-level on the Indian River, extends due west about one mile before entering the valley of the stream. After following the stream a distance of about 1,000 feet, and having passed under both the railroad and the public road, the canal leaves the valley near the union of the two tributaries, cuts through the beach, and extends inland in a general southwesterly direction about 12 miles. The water level in the canal at low-water stage at the locality where the fossils were found is probably not more than 1 foot above sea, although upon crossing the beach the water level is lifted by means of a spillway to approximately 11 feet above mean sea-level. The land surface for a distance of 12 or 15 miles inland probably nowhere exceeds an elevation of 20 or 25 feet, except Ten Mile Ridge, which is 34 feet above mean sea-level.

DESCRIPTION OF THE SECTION THROUGH THE STREAM VALLEY INCLUDING STRATA NUMBERED 1, 2, AND 3

The section through the stream valley, as exposed in the canal bank, includes three more or less well-marked divisions, which in the present, as in the preceding papers, may be numbered 1, 2, and 3, No. 1 being at the base of the section and No. 3 at the top. In No. 3 of the section are found human remains and artifacts, vertebrate, land and fresh-water invertebrate, and plant fossils. In No. 2 are found human remains, flint spalls, and probably also bone implements, as well as vertebrate, land and fresh-water invertebrate, and plant fossils. From the basal member of the section, a marine deposit, no human remains have been obtained.

To what extent the three divisions of this section represent distinct time intervals, and, on the other hand, to what extent they may intergrade and thus express continuity of time, is discussed subsequently. These divisions are sufficiently well marked to be recognized throughout the greater part or all of the section, and serve as convenient markers in the exact placing of fossils.

The marine deposit, No. 1 of the section, is common to this part of the Atlantic Coast of Florida, and is known to extend both to the north and to the south, being a part of an extensive shallow-water marine formation which borders the Atlantic Coast in Florida for a distance of 200 or 300 miles. This stratum is prevailingly a shell marl, although it contains considerable sand, and in places may consist wholly of sand of medium fine texture. A large exposure, however, will scarcely fail to reveal the presence of the marine shells.

Stratum No. 2, on the other hand, is probably local, representing fill in the stream valley, although its time equivalent, as indicated by the fauna, is found at many localities throughout the state. This deposit in the stream valley averages 3 or 4 feet in thickness, and consists chiefly of rather coarse sand, which at the top as a rule grades into fresh-water marl. Within the stratum, filling holes or channels in the underlying deposit, are found local accumulations of muck, including often wood, sticks, acorns, snail shells, and vertebrate fossils. As a rule the sand near the base of this stratum is light-colored and distinctly cross-bedded, the heavy minerals, including staurolite, ilmenite, and quartz, being deposited in bands and in pockets according to the size of the grain and the specific gravity of the minerals. From 2 to 3 feet above the base of the stratum the sand loses its cross-bedding and becomes dark in color, owing to the inclusion of organic matter. At the top, as has been stated, the sand passes into marl, containing an abundance of land and fresh-water invertebrates.

Stratum No. 3 consists chiefly of layers of muck and vegetable material, alternating with layers of loose, nearly pure, light-colored sand. This alternation of sand and muck is both abrupt and frequent, the layers in places having only a thickness of from one-half to 2 or 3 inches. At the top this stratum grades into a fresh-water marl which, in places, reaches a thickness of 18 inches. The maximum thickness of this stratum is about 5 feet, although its average thickness is from 2 to 3 feet.

The accompanying sketch, Fig 2, shows the section exposed in the north bank of the canal from the railroad bridge west for a distance of 500 feet. No. 1 is the marine shell marl; No. 2 is the sand stratum which at the base is cross-bedded and at the top passes into fresh-water marl; No. 3 is the deposit of muck and vegetable material with alternating layers of incoherent sand. The letter *b* indicates the location of one of the holes or channels in the shell marl containing muck and driftwood as well as vertebrate, invertebrate, and plant fossils.

In Fig. 3 is shown a section, drawn to scale, of 75 feet of the south bank of the canal, showing the exposure as seen in November, 1916. This section includes that part of the bank west of the entrance of the lateral canal from the south, and thus passes through the exposure at which some of the important fossils have been found. Stratum No. 1 has an approximately even top surface, although at one place near the middle of the section it is cut into rather deeply by stratum No. 2. This place, in fact, represents another of the holes or channels in No. 1 filled with muck and decayed wood. Stratum No. 2 is variable in thickness, being cut into at places by stratum No. 3. Stratum No. 3 as seen in this section is variable both in thickness and in lithologic characteristics. Its maximum thickness near the middle of the section is about 5 feet, the upper 18 inches of which is a fresh-water marl. The top or ground surface of this stratum is cut into at *a* and at *b*. The cut at *a* was probably made in connection with dredging operations. That at *b*, however, is evidently the channel of the modern stream where it cut into stratum No. 3.

At the point *f* in this section the muck and alluvial material of No. 3 grades laterally by an indefinite line into the marl rock. In the writer's former papers the whole section at *e* was referred to stratum No. 2, No. 3 being interpreted as absent at this place. The present exposure apparently indicates that the two feet of marl at *e* is the equivalent of the muck and marl bed of No. 3. A similar section is seen on the opposite or east side of the lateral

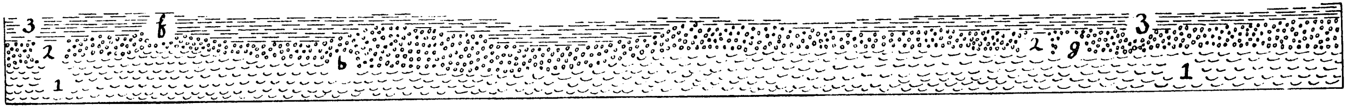

FIG. 2.—Section on the north bank of the canal from the Florida East Coast Railroad bridge west, a distance of 512 feet. No. 1, marine-shell marl and sand; No. 2, fresh-water sand, muck, and marl bed, containing land and fresh-water invertebrate, plant, and vertebrate fossils; No. 3, incoherent sand and muck containing plant and animal fossils. The type specimen of *Canis ayersi* was found at *g*; the type specimen of *Jabiru? weillsi* was found at *b*. Horizontal scale, 1 inch = 73 feet; vertical scale, 1 inch = 25 feet.

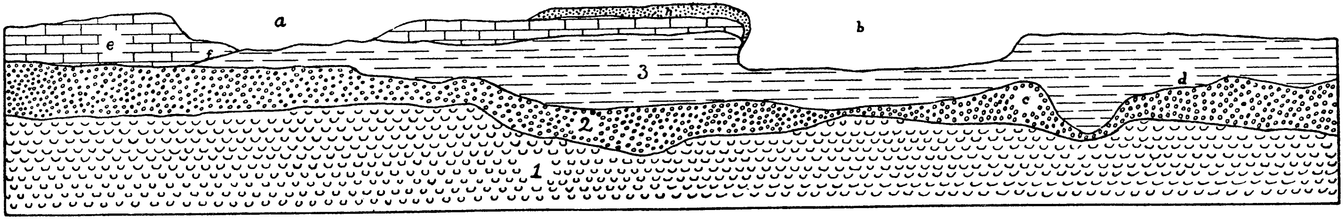

FIG. 3.—Section on the south bank of the canal from the entrance of the lateral canal west, a distance of 77 feet. Vertical and horizontal scale, 1 inch = 11 feet. No. 1, marine-shell marl; No. 2, fresh-water sand; No. 3, stratified deposit consisting of alternating layers of incoherent sand and muck, and grading at the top into a fresh-water marl. Near the place indicated by *f* this stratum grades laterally into the fresh-water marl. The original soil, as well as the full thickness of stratum No. 3, is seen at *h*. The cut at *a* was possibly made in connection with the dredging operations; the cut at *b* indicates the location of the modern stream channel.

canal, and apparently the marl rock of that section may also be referred to stratum No. 3. This part of the section will be more fully discussed subsequently.

The sketch, Fig. 2 of this paper, may be compared with Fig. 6 of the writer's paper in the *Eighth Annual Report of the Florida Geological Survey,* in which is shown a part of the same bank, including the location of the important fossils. Although this part of the canal bank was afterward carried back by excavations a distance of from 5 to 8 feet, the fossils of the former sketch may, as a matter of convenience, be projected on to the present sketch, as has been done in this figure, thus indicating their approximate location with respect to the section as now exposed. Human bones were found in No. 2 at *c* (projected from the former section) and in No. 3 at the general locality indicated by *d.* Pottery and bone implements are found in No. 3 throughout the section.

HUMAN REMAINS AND ARTIFACTS FROM STRATUM NO. 2

The first human bones obtained at Vero were found in the south bank of the canal, 330 feet west of the bridge. In the exposure at this place there is no recognizable break in the section from the base of stratum No. 2 to the marl rock at the top of the section, and in the writer's earlier papers the whole section was referred to stratum No. 2. The new observations recorded in this paper apparently permit the reference of the marl rock at the top of the section to stratum No. 3. If this is true, the human bones at this place in stratum No. 2 are beneath the one and one-half or two feet of marl rock which represents stratum No. 3.

The second lot of human bones from stratum No. 2 were found by the writer in June, 1916. The bones found in place include an astragalus, a cuneiform, and a part of an ilium. Upon sifting the sand in which these bones were imbedded there was obtained in addition two phalanges, a section from a limb bone, and some other human bone fragments. The cuneiform was about 10 inches from the astragalus, and between the two bones at the same level as the astragalus was the scapula of a deer. The ilium was about one foot farther back in the bank. The vertebrate fossils found in the bank at this locality have been listed in the papers previously published.

The flints obtained from stratum No. 2 include a spall found in place 3 feet east of the human bones listed in the preceding paragraph, and about one foot farther back in the bank. Upon passing the sand through a sieve five additional flint spalls were obtained from this stratum, one of which was found about 10 feet farther west. From these siftings were obtained also one nearly complete small bone implement and a piece of a second bone implement. Markings on bones from this stratum, which may have been made by tools, have been described in the papers to which reference has been made.

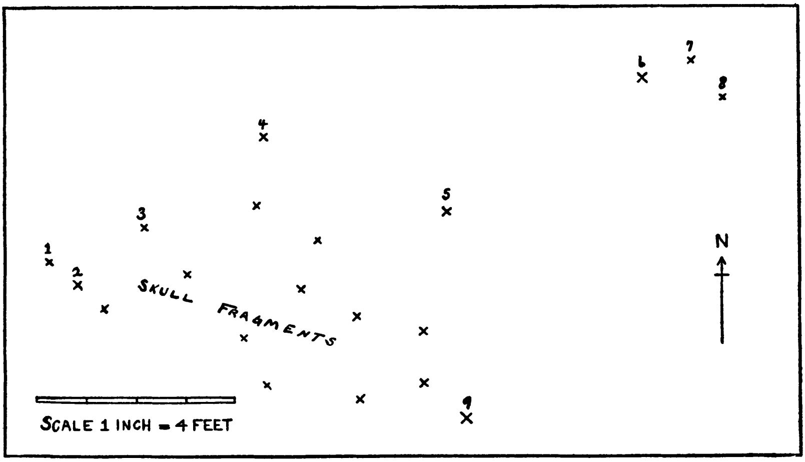

FIG. 4.—Ground plan showing the location of human bones found in the canal bank at Vero in April and in June, 1916. The canal bank at this place faces approximately northwest and those bones, the location of which is indicated by Nos. 1–5, and also several of the skull fragments, were collected in April. Those bones numbered 6–9 and a few skull fragments were collected in June. Among bones not specially numbered are a part of the right femur and an incisor tooth found near No. 9, and a part of a metatarsal found near No. 2. The bones indicated by Nos. 1–5 and No. 9 and several of the skull fragments were found on or near the contact line of strata Nos. 2 and 3. Those bones indicated by Nos. 6–8 were found in stratum No. 2. Bones taken from the caving of the bank and from siftings are not shown in this plan. Index to bones: 1, left ulna; 2, a part of the shaft of the same bone; 3, left femur; 9, a part of the shaft of the same bone; 4, radius; 5, metatarsal; 6, astragalus; 7, external cuneiform; 8, part of ilium. The place in the bank of bones Nos. 1, 3, and 4, and bones Nos. 6 and 7, is shown in photographs previously published.

The spalls found in this stratum have been placed in the hands of Dr. George Grant MacCurdy, who has consented to report upon them. It is evident that these flints are not of local origin, the nearest known outcrop of a flint-bearing formation being more than 100 miles to the northwest. The flint spalls are sharp-edged and quite unworn, indicating that they have been transported no great distance by water. The small flint pebbles occasionally found in this deposit, on the contrary, are rounded and well worn, there being no intermediate stages between the worn pebbles of the deposit and the sharp-edged spalls.

HUMAN REMAINS AND ARTIFACTS IN STRATUM NO. 3

Three finds of human skeletal material are reported from stratum No. 3. In each instance the bones lay at the contact line between strata Nos. 2 and 3, and hence may belong to No. 2 rather than to No. 3. The first of these discoveries was in the south bank of the canal at the locality shown in Fig. 3. The bones obtained at this place include the right and left ulna, part of a humerus, a scapula, two incisors, parts of right and left femora, a radius, part of a jaw, two metatarsals, and a considerable portion of the skull, the pieces of which were dissociated and scattered. All of these bones were on or very near the contact line between Nos. 2 and 3, and, as they are near the place where human bones were found in No. 2, they may have been derived from stratum No. 2 and, as the writer has previously suggested,[1] may pertain to the same individual as the bones found in No. 2.

The second discovery of human remains referred to stratum No. 3 was made by Isaac M. Weills, who in April, 1916, obtained a single human toe bone from the base of stratum No. 3 on the north bank of the canal, 419 feet west of the bridge. A third discovery of human skeletal material from this stratum was made also by Mr. Weills, who in June, 1916, obtained a single human tooth from the base of No. 3, on the north bank of the canal, 450 feet west of the bridge. All of the human skeletal material obtained at Vero has been placed in the hands of Dr. A. Hrdlička, who, it is hoped, will discuss their relation to the modern races.

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[1] *Fla. State Geol. Surv.*, *Eighth Annual Report*, p. 142, October, 1916.

In addition to the skeletal material a large number of artifacts have been obtained from stratum No. 3. A small arrowhead was taken from this stratum by Mr. Weills in April, 1916. A rather large arrowhead was obtained from near the base of the deposit by the writer in June, 1916. Two spalls have been found near the contact line of strata Nos. 2 and 3, and four others have been obtained in siftings from No. 3. From this deposit has been taken about two dozen bone implements, as well as one wood implement and one object, probably a section from an alligator tooth, which apparently was used as an ornament. Broken pottery is not uncommon in this stratum, about one hundred or more pieces having been collected. Neither the pottery nor the bone implements are restricted in their occurrence. On the contrary, they are common to this horizon and are found at places where the horizon reaches its maximum thickness and retains its covering of marl rock, as well as at other places where the stratum is thinner and has been cut into by the recent stream bed.

FOSSILS FROM STRATUM NO. 1

Stratum No. 1, as previously noted, is a marine deposit in which invertebrates are abundant and well preserved, the natural coloration of the shells being in some degree retained. No vertebrate fossils are known from this stratum at this locality, although from shell marl, probably equivalent in age, at West Palm Beach the writer has obtained the distal end of the humerus of a camel.

A collection of invertebrates from this horizon was made by the writer in 1915 and submitted to Dr. T. W. Vaughan, in charge of Coastal Plains investigations of the United States Geological Survey. The mollusks of this collection have been identified under Dr. Vaughan's direction by Mr. Wendell C. Mansfield. Of forty-two species definitely identified (17 gastropods and 25 pelecypods), all, according to notes kindly supplied by Mr. Mansfield, are identical with the species believed to be now living. One species only, an *Arca*, is regarded by Mr. Mansfield as intermediate between the recent *A. ponderosa* and the probably extinct *A. limula*. It appears, therefore, that the marine molluscan fauna of stratum No. 1, as well as the land and fresh-water molluscan fauna of stratum No. 2, is essentially identical with the modern molluscan fauna. In this respect the invertebrates are in very decided contrast to the vertebrates among which are many extinct species.

FOSSILS FROM STRATUM NO. 2

To the mammals previously listed from stratum No. 2[1] may now be added the genus *Mylodon*, evidence of the presence of which in stratum No. 2 was obtained in connection with the conference of geologists and anthropologists held at Vero in October. Among other important fossils added in November were about thirty bones from the skeleton of the large extinct wolf, *Canis ayersi*. These bones were found in the canal bank, from 7 to 10 feet west of the place from which the skull and femur which served as the type specimen of the species were found, and probably belong to the same individual. From the north bank of the canal, 460 feet west of the bridge, was obtained a practically complete skull of the tapir, lacking only the lower jaw. From the south bank of the canal at the railroad bridge was obtained about 4½ feet of the tusk of a proboscidian. This tusk was found at the same place and probably pertains to the mastodon, a part of the skull of which had previously been secured. The recovery of these fossils was due chiefly to high water in the canal, following heavy rains at the close of October. The water cleaned the banks of the canal, thus facilitating both the examination of the section and the collecting of fossils. To the birds, of which two species were previously known, a third species, represented by a humerus, may now be added. To the other fossils of this stratum—the plants, invertebrates, fishes, batrachians, and reptiles—no species so far as known are added in the new collections. The land and freshwater invertebrates, which include about twenty-eight identifiable species, have been determined as previously reported by Dr. Paul Bartsch and are found to be identical with the modern species. The turtles have been identified by Dr. O. P. Hay and have been found to include chiefly extinct species.

[1] *Fla. Geol. Surv., Eighth Ann. Rept.*, p. 158.

The following is a list of the mammals of stratum No. 2, which fully establish the Pleistocene age of the deposit:

Didelphis virginiana
Megalonyx jeffersonii
Mylodon sp.
Chlamytherium septentrionalis
Dasypus sp.
Equus leidyi
Equus complicatus
Equus littoralis
Tapirus sp.
Odocoileus sp.
Bison sp.
Peccary, indt.
Camel, indt.
Mammut americanum
Elephas columbi
Neofiber alleni
Sylvilagus sp.
Sigmodon sp.
Cryptotis floridana
Blarina sp.
Smilodon sp.
Hydrochoerus sp.
Procyon lotor
Lutra canadensis
Canis ayersi

The Pleistocene fauna of this horizon is found at many places in Florida. Some of the localities on or near the Gulf Coast from which a typical representation of this fauna has been obtained are Peace Creek, Sarasota Bay, the Caloosahatchee River, the Withlacoochee River, and cave deposits at Ocala. Other localities on or near the Atlantic Coast from which this fauna is known include Daytona, Fellsmere, Palm Beach, Eau Gallie, and St. Augustine. The mammalian species known from these different localities have been listed by the writer in a paper recently published.[1]

FOSSILS FROM STRATUM NO. 3

The fossils of stratum No. 3, which include plants, insects, land and fresh-water mollusks, fishes, batrachians, reptiles, birds, and mammals, have not been fully identified, and hence cannot be discussed in detail at this time. Mr. E. W. Berry has kindly undertaken the identification of the plants. The insects, of which only a few have been obtained, have been submitted to Professor H. F. Wickam. The land and fresh-water mollusks are few in number, and presumably are identical with the modern species, since those of the older deposit, stratum No. 2, according to Dr. Bartsch, are not separable from the modern forms. The fish remains, which are fragmentary, are in the hands of Dr. Charles R. Eastman. The birds of this deposit are being studied by Dr. R. W. Shufeldt.

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[1] "Fossil Vertebrates from Florida; A New Miocene Fauna; New Pliocene Species; the Pleistocene Fauna," *Fla. Geol. Surv., Eighth Annual Report*, pp. 77–119, Pls. 10–14, 1916.

The turtles from stratum No. 3 have been studied by Dr. O. P. Hay, who finds that six species are present. Of these six species three are extinct, one is sub-specifically different from the modern, and two are apparently not separable from the modern species. The mammals, the identification of which has been approximately completed, are more abundant than the turtles. The species of mammals recognized include the following:

Didelphis virginiana
Chlamytherium septentrionalis
Dasypus sp.
Odocoileus sp.
Neofiber alleni.
Sylvilagus sp.
Sigmodon sp.
Neotoma sp.
Scalopus sp.
Vulpes sp.
Canis cf. latrans
Procyon lotor?
Lutra canadensis
Lynx sp.
Ursus, indt.

The extinct genus of armadillo-like animals, *Chlamytherium*, is represented by well-preserved, uneroded dermal scutes. The armadillo, *Dasypus*, is likewise represented by dermal scutes. The fox, which differs from the species at present known in Florida, is represented by a part of the lower jaw containing two premolar teeth, and by a single premolar tooth obtained from the fresh-water marl rock on the south bank of the canal, 335 feet west of the bridge. The rock at this place, as previously mentioned, has heretofore been placed in stratum No. 2, but at present is regarded as probably equivalent to stratum No. 3. *Canis* cf. *latrans* is represented by a part of the upper jaw containing the carnassial tooth. The lynx is represented by a jaw and a tibia. Parts of the teeth of *Elephas columbi* and of *Mammut americanum* are by no means uncommon in this stratum. The tapir and horse are also represented, although by fragmentary material.

Dr. R. W. Shufeldt has very considerately submitted an abstract of his report on the fossil birds found at Vero, with permission to insert it here in advance of the publication of the report as a whole. The abstract includes all bird material obtained at Vero except a stork, *Jabiru weillsi*, previously described by the writer, and a left humerus of a passerine bird related, according to Dr. Shufeldt, to the meadow larks. These two species and the first of the following list, No. 7550, are from stratum No. 2 of the section. All other birds of this list are from stratum No. 3.

REPORT ON FOSSIL BIRDS FROM VERO, FLORIDA, BY R. W. SHUFELDT

No. 7550. The right humerus, nearly perfect, of a teal. This bone I have carefully compared with all the humeri of our smaller existing ducks of various genera. It comes quite close to *Querquedula discors*, but belonged to a different species of that genus. I propose to describe it as *Querquedula floridana*.

No. 6934. This is the distal moiety of the right *tibio-tarsus* of a barn owl (*Tyto pratincola*). The condyles are slightly chipped off posteriorly.

No. 6773. Distal half of the right tarso-metatarsus of a water bird; probably a *Larus*, about the size of *Larus atricilla*. Whether this belonged to the same specimen as the next (No. 6933) I cannot say.

No. 6933. Left carpo-metacarpus of some tern or gull; I am inclined to believe, from the slight preponderance of characters, a gull of the genus *Larus*. It was a considerably larger species than *Larus atricilla*, but comes close to it. It was also a larger bird than *Stirna maxema*. I have compared it with the corresponding bone in many species of terns and gulls. Apparently it does not represent any of our existing forms. For this doubtless extinct species I propose the name of *Larus vero*.

No. 7552. Humerus (right side), imperfect; head of bone not recovered. Length of fragment 8.35 cm. No. 6797. The shaft of an ulna of a large bird. No. 6932. Piece of a long bone, the shaft (humerus?) of some large bird. These three specimens too fragmentary for reference.

No. 7005 (in two pieces; smaller fragment not numbered). The left ulna of *Cathartes aura*.

No. 6774. The distal two-thirds of the left tarso-metatarsus (imperfect), of some heron (*Ardea*), larger than *Nycticorax n. naevius*. Not quite perfect enough for exact reference.

No. 6932. The distal portion of the left tarso-metatarsus of *Ardea herodias* (adult); the trochleae slightly abraded posteriorly.

No. 7554 (including three vertebrae). The two small vertebrae are from a bird, and belong to the distal end of the cervical chain. It is hardly possible to say to what kind of bird they belong, though they agree more or less with the posterior cervical vertebrae of several average waders. The large elongate vertebra is from the cervical region of another wader, a true heron of the genus *Ardea*. I have compared it with the corresponding bone in the neck of all our medium-sized waders, as herons, spoonbills, egrets, and many others, and I find that, in all particulars, it comes nearest to the same vertebra in *Herodias* *egretta.* However, I would hardly feel justified in making a new species of this, unless it was associated with other bones belonging to the same skeleton. I would suggest, therefore, that it be set aside to await the discovery of additional material from the same locality and the same excavation.

In this little lot there still remains the distal extremity of a small right tarso-metatarsus, which is quite perfect as far as it goes. It belonged to some sort of average-sized wading bird, perhaps after the heron order, or a near ally. I have compared it with the corresponding part in some thirty skeletons of existing birds; but, while it comes pretty close to some of them, it presents departures of such a nature that it does not agree with any of them. I am not prepared to describe it as coming from a new and extinct bird; but I would suggest that it be set aside to await the discovery of additional material from the place where it was found.

No. 7551. This is the distal portion of a right tibio-tarsus of a heron somewhat smaller than *Ardea herodias*, but specifically distinct from it. The condyles are considerably abraded, but otherwise the specimen is perfect as far as it goes. The intercondylar valley is narrower and shallower than we find it in *Ardea herodias*, and the anterior tendinal groove in the fossil rapidly contracts as it proceeds up the shaft, to become very narrow about 2 cm. above the osseous tendinal bridge. This is not the case in *Ardea herodias*, wherein the anterior surface of the shaft in that locality is flat, and barely exhibits any tendinal groove. There are a few other points of difference, which, taken in connection with what is set forth above, inclines me to believe that this bone belonged to a heron of the genus *Ardea*, of about the same size as the existing *Ardea herodias*, but specifically distinct from it. For this apparently extinct heron I here propose the name of *Ardea sellardsi.*

No. 7000. An imperfect distal third of the right tarso-metatarsus of a large wader. Unfortunately the trochleae are nearly all fractured off; still the characters of this bone are so pronounced that I have no hesitation in referring it to some species of *Mycteria*, and it probably belonged to a wood ibis, *Mycteria americana*, with which I have compared it. So far as the fragment goes, it does not seem to offer a sufficient number of characters to separate it from that species.

It is thus found that stratum No. 3 of the section at Vero contains extinct species of each of the three vertebrate classes—reptiles, birds, and mammals. Since this deposit, No. 3, rests upon the fossiliferous stratum, No. 2, it becomes necessary to inquire to what extent these fossils may possibly have washed from the underlying deposit. With regard to birds, those of No. 3 are more abundant both in specimens and in species than are those of No. 2. Moreover, the bird bones are fragile and would not withstand washing from one formation to another. That the extinct turtles do not represent inclusions from the older formation is evident by the fact that practically complete carapaces are found, which in some instances are so delicate as not to stand so much as turning over without being broken. That the mammals referred to No. 3 are normal to that deposit is indicated both by the abundance of the bones and by their condition of preservation.

INTERPRETATION OF THE SECTION

It is desirable in this connection to consider the interpretation of the section as a whole, especially as to whether or not an appreciable period of time intervened between the deposition of divisions 1 and 2 of the section, and also between divisions 2 and 3. As a rule, it is possible to recognize the dividing line between the marine stratum, No. 1, and the fresh-water deposit, No. 2. At such places, even though the marine shells are lacking in No. 1, there is a change in the texture, and usually also in the color, of the sand. Moreover, one finds rather commonly irregularities at the top of No. 1, which are due to stream wash. Occasionally there are also depressions or holes in the top of No. 1. Such holes, so far as observed, as previously stated in this paper, contain muck and decayed wood and sticks. However, notwithstanding this apparently well-marked break, there are other places where the dividing line between Nos. 1 and 2 is evident neither by the change of texture of the sand nor by any change in color. At such places deposition appears to have been continuous from stratum No. 1 into stratum No. 2. On the other hand, there is at all places evidence of the change from marine to fresh-water deposition. Since the fossils of No. 1 are marine, while those of No. 2 are land forms, there is little opportunity of connecting the two divisions by means of the fauna. Aside from the one camel bone obtained at West Palm Beach, no land animals are known from No. 1 of this section.

In the preceding papers the writer has commented upon the abrupt break which normally exists between strata Nos. 2 and 3, a break which it seemed possible might be taken to indicate a considerable interval of time. The later observations of this section, however, as previously stated in this paper, indicate that a part of the section heretofore referred to No. 2 is possibly the equivalent of No. 3. It seems not impossible, therefore, that the break between divisions 2 and 3, which is so evident throughout a large part of the section, may be due to local re-working by the stream of its own bed in Pleistocene time, and that the deposit designated as stratum No. 3 is itself a phase of stratum No. 2, being analogous to the smaller deposits of muck and decayed wood found near the base of No. 2, which are known to be inclusions within that stratum. On the question of the interrelation of the three divisions of the section, however, it will perhaps be necessary to await the accumulation of further evidence, both stratigraphic and paleontologic.

RELATION OF THE HUMAN REMAINS TO THE ASSOCIATED FOSSILS

It will scarcely be maintained that the human remains and artifacts obtained from stratum No. 3 are otherwise than normal to that deposit. Their abundance, their general distribution, and their presence within and at the base of a stratified and undisturbed deposit preclude any reasonable contention that they are otherwise than contemporaneous with the associated materials of the deposit. The study of the fossils of this stratum, although not yet completed, has brought to light the presence of a considerable number of extinct species which suggest the reference of the deposit to the Pleistocene period.

Special interest is attached to the human remains and artifacts from stratum No. 2, this being the oldest deposit from which human material has been obtained. This stratum is easily recognized, and at the present time may be followed on both the north and south banks of the canal through the whole section. The vertebrate fauna by which the Pleistocene age of the deposit is determined is also well represented in the collections that have been made at this locality. That the human bones are fossils normal to this stratum and contemporaneous with the associated vertebrates is determined by their place in the formation, their manner of occurrence, their intimate relation to the bones of other animals, and the degree of mineralization of the bones. The presence of flint spalls, and the probable presence of bone implements add support to the evidence obtained from the bones themselves.

The place of the human bones in the formation affords a strong argument for their contemporaneity with the associated fossils. Those human bones found in the south bank of the canal, 330 feet west of the bridge, lie beneath 18 inches of marl rock. The human bones found in the same bank, 462 feet west of the bridge, lie beneath 4 feet of stratified deposits consisting of alternating layers of sand and muck, which could not have been dug through and replaced without interrupting the continuity of the strata. Moreover, the presence of the muck, as well as the conditions of preservation of the plant remains, indicates that this locality has been continuously moist since the materials of both Nos. 2 and 3 were deposited. Aside from the improbability of locating a grave in a muck bed, it is probably impossible without special appliances to dig a grave through an undrained muck bed on account of the presence of ground-water. If it be suggested that the human remains in stratum No. 2 represent a burial, it must be recognized that the reference is not to a recent burial, but to a burial antedating the deposition or existence of stratum No. 3 of the section, and hence to an event that occurred probably within the Pleistocene period of time. There is, however, strong evidence that the human remains in this deposit do not represent a burial by human agency, but are fossils normal to the stratum, having been included in the earth in the same way and at the same time that the other bones were buried in the accumulating deposits.

The manner of occurrence of the human bones is entirely similar to that of the other vertebrate fossils. Whole skeletons are not found, and, indeed, complete bones are by no means common. On the contrary, the human bones as well as the bones of the other animals are scattered, imperfectly preserved, and frequently broken. The breaks in the bones are as a rule sharp-edged, and it would seem that in the case both of the human and of the other vertebrates the bones were more or less disturbed after they had lost enough of the organic matter to become sufficiently brittle to break as they were moved about by water before reaching their final resting-place. An illustration of the way in which the bones were broken is afforded by a fragment from the shaft of a human limb bone, No. 6958. This piece of bone is broken with a sharp fracture at each end. The breaks are old and were made at the time that the bone was imbedded in the sand. The intimate association of the human and other fossils is difficult to explain except upon the recognition of their contemporaneity. The human astragalus and cuneiform were separated by a space of about 10 inches, and between them at the same level as the astragalus was the scapula of a deer. Bones from the skeletons of other animals were near by in the same stratum and have been described in the writer's previous papers.

In the number of bones that have been obtained representing a single individual there is observed no important difference between the human and the other animals. The most nearly complete skeleton that has been obtained is that of an alligator. The next largest number of bones found, about thirty or thirty-five in number, from the skeleton of a single individual are those of the extinct wolf, *Canis ayersi*. Among the most perfectly preserved individual bones that have been obtained from the deposit are those of the bird, *Jabiru? weillsi*, the femur of a horse, the lower jaw of *Chlamytherium*, and part of the skull and tusk of a proboscidian. Entirely surpassing any of the human bones in perfection of preservation is the skull of the extinct wolf and the skull of the tapir. The tapir skull, so far as the writer has been able to learn, is the first approximately complete skull of this animal that has been obtained from the Pleistocene of North America.

The degree of mineralization of the human bones is identical with that of the associated bones of the other animals, a fact that has been brought out in the papers previously published by the writer. The spall found in place in this stratum, as well as the several other flints obtained from siftings, is totally unlike any flint pebbles in the deposit. The reasonable explanation of the presence of these spalls in this stratum is that they washed in from the near-by land surface, together with the other materials of the deposit. In other words, they pertain to the Pleistocene period and were washed into the deposit at that time. The bone implements, although obtained from the siftings and hence not seen in place, are, with little doubt, to be attributed to the same source.

The presence of man in the Pleistocene of Europe has long been known, and his assumed absence from the Pleistocene of America is based entirely on negative evidence. How insecure as a basis of argument in paleontology is negative evidence has been repeatedly demonstrated, and new groups with Old World affinities are constantly being recovered from the North American formations. A striking illustration is the eland obtained in 1913 by Gidley from the Pleistocene of Maryland, the relationship of which is closer to the modern eland of Africa than to any other known species, the dispersion and migration of the group having probably occurred during the Pleistocene period.[1] Another illustration is afforded by the bears. Heretofore, it has been assumed that members of the bear group were comparatively recent migrants to the New World, but during the past summer representatives of the true Ursidae were obtained practically simultaneously in Oregon[2] and in Florida.[3] Numerous other illustrations might be given, and in fact the rapidity with which new species are being obtained and described is evidence of our heretofore imperfect knowledge of the Pleistocene faunas. Man lived with and hunted *Elephas primigenius* in Europe, and it is not improbable that he may have followed the spread of that species to America. The evidence obtained at this new locality in Florida, supplementing the less positive evidence that has heretofore been available, affords proof that man reached America at an early date and was present on this Continent in association with a Pleistocene fauna.

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[1] James Williams Gidley, "An Extinct American Eland," *Smithsonian Miscellaneous Collections*, LX, No. 27 (March, 1913).

[2] John C. Merriam, Chester Stock, and Clarence L. Moody, "An American Pliocene Bear," *Univ. of Cal. Publ.*, X, No. 7 (November 1, 1916).

[3] E. H. Sellards, "Fossil Vertebrates from Florida," *Fla. Geol. Surv., Eighth Annual Report* (October, 1916).